Space Weather Technical Forecast

Issued on Friday, 10 March 2023 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares (R1-R2/Minor-Moderate radio blackouts) likely throughout. Diminishing risk of Active electron fluence

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours with a number of C-class flares. The strongest of these was a C6.2 flare from AR3245 at 09/2024UTC. Overall there are 11 sunspots visible on the disc, with only AR3242 and AR3245 complex enough to pose a significant flare risk. Both of these regions carry a βγ classification, with AR3245 simplifying after recently seeing a delta spot fade. The remaining regions are all weak and magnetically simple alpha or beta regions. A farsided halo CME was observed leaving the Sun during 09 Mar but initial analysis suggests that this does not have an Earth-directed component. Further analysis is currently under way to confirm this initial analysis.

Solar Wind / Geomagnetic Activity: The solar wind speed have been between 400-450km/s due to the weakening influence of coronal holes 81 and 82. Density was around or below average. Total magnetic field strength was mainly weak, but briefly reached moderate levels between around 09/0330UTC and 09/1100UTC, probably due to a transient weak CME embedded in the solar wind. The north-south component generally varied weakly between negative and positive levels, but was moderately negative between around 09/0300UTC and 09/0700UTC. Phi angle was mainly negative (towards the Sun) throughout. Geomagnetic activity was mainly Quiet to Unsettled, but was Active to G1/Minor Storm between 09/0600-1200UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at background levels. High energy electron flux (greater than 2MeV) has varied between mainly moderate and high levels, with declining peaks, from a peak of 2780pfu at 09/0130UTC. Electron fluence has followed a declining trend, falling to 7.09e7 integrated pfu at 10/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is likely to be Low to Moderate due to two large regions on the visible disc. There is also a slight chance of High activity.

Solar Wind / Geomagnetic Activity: No CMEs are forecast to affect the Earth in the next four days. A coronal hole high speed stream is expected to decline to background levels through the next 24 hours, with no further coronal hole HSS connections forecast. Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp 1-3), throughout the period.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, as observed by GOES16, is currently at background levels but with a slight chance of reaching S1 or greater should any larger flares occur. High energy electron flux levels (greater than 2MeV) are expected oscillate between moderate and high levels. Electron fluence is expected to decline and remain below the Active threshold.

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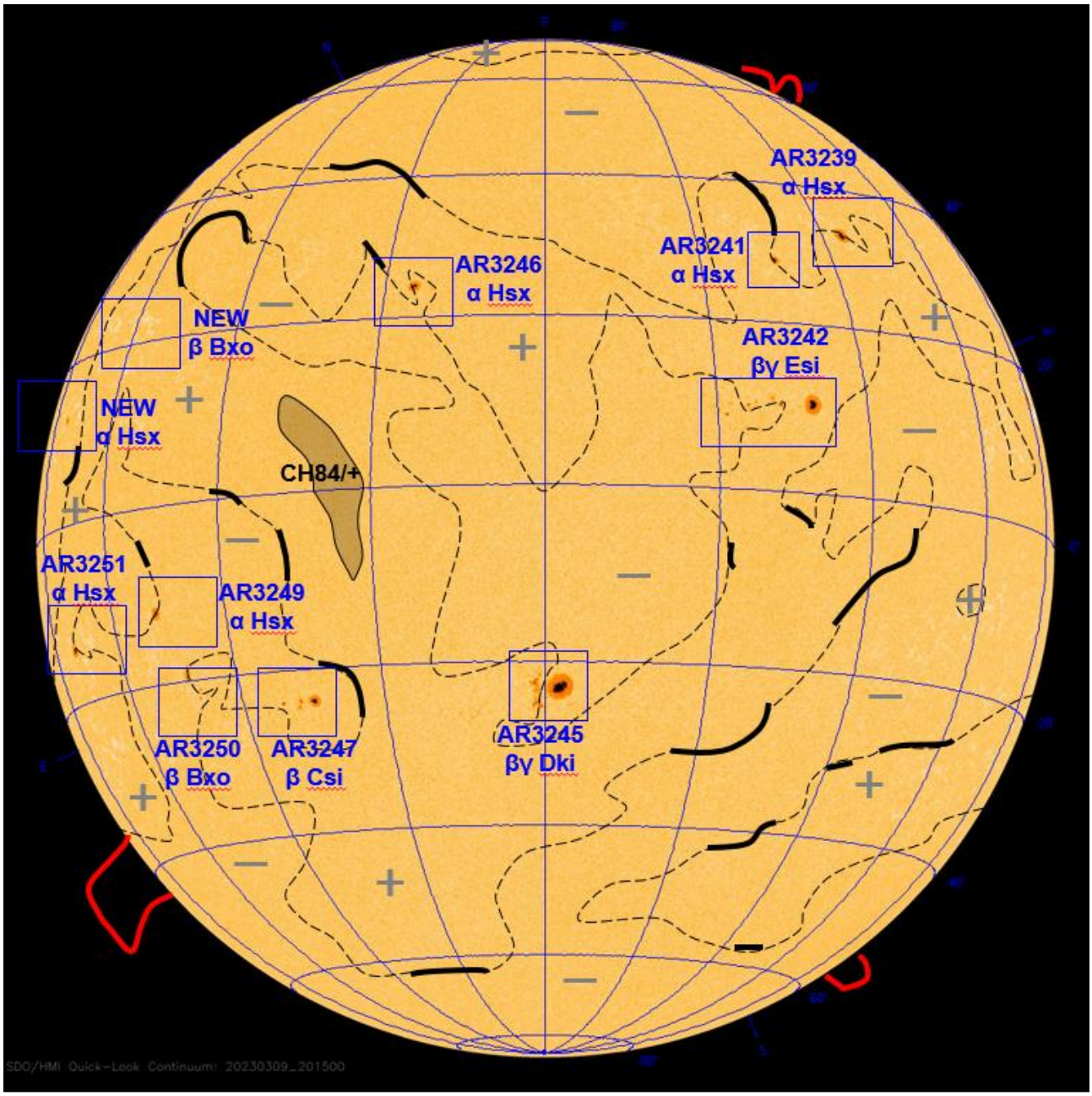
Figure 1. Solar Analysis Valid 09/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A full halo CME which appears to have left from beyond the western limb during 09 Mar is currently being analysed to determine if there is an Earth directed component, although initial analysis suggests that this may be directed away from the Earth.

Coronal hole 82 is currently weakly connected to the Earth with a decline to background levels likely through 10 and 11 Mar. No further coronal hole are expected to affect the earth through the forecast period.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled, but this is subject to further analysis of the coronal mass ejection.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Farsided CME observed on LASCO C3 imagery and Enlil analysis showing that an Earth-directed component is unlikely.

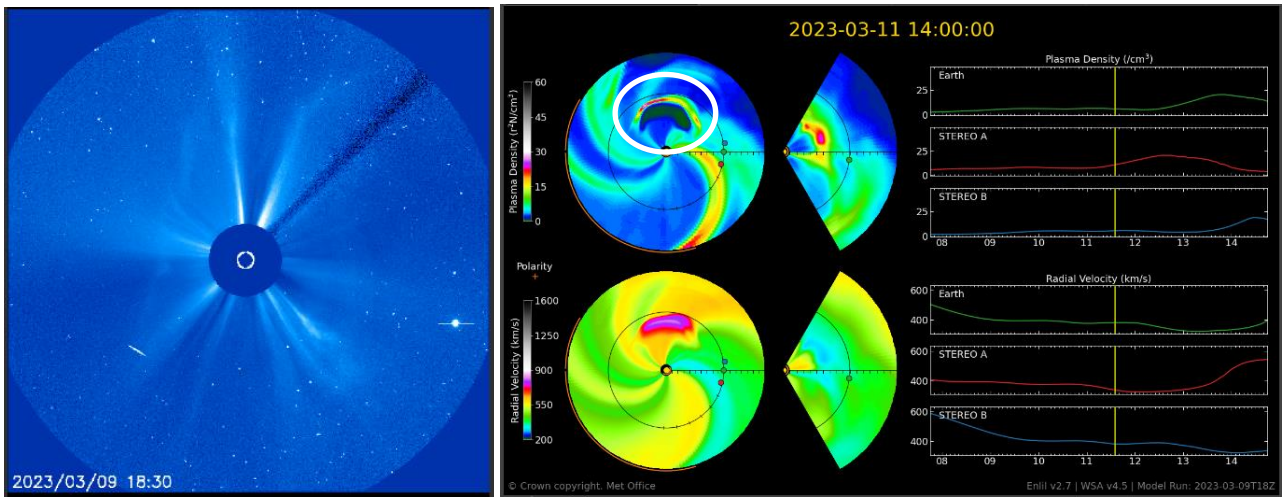

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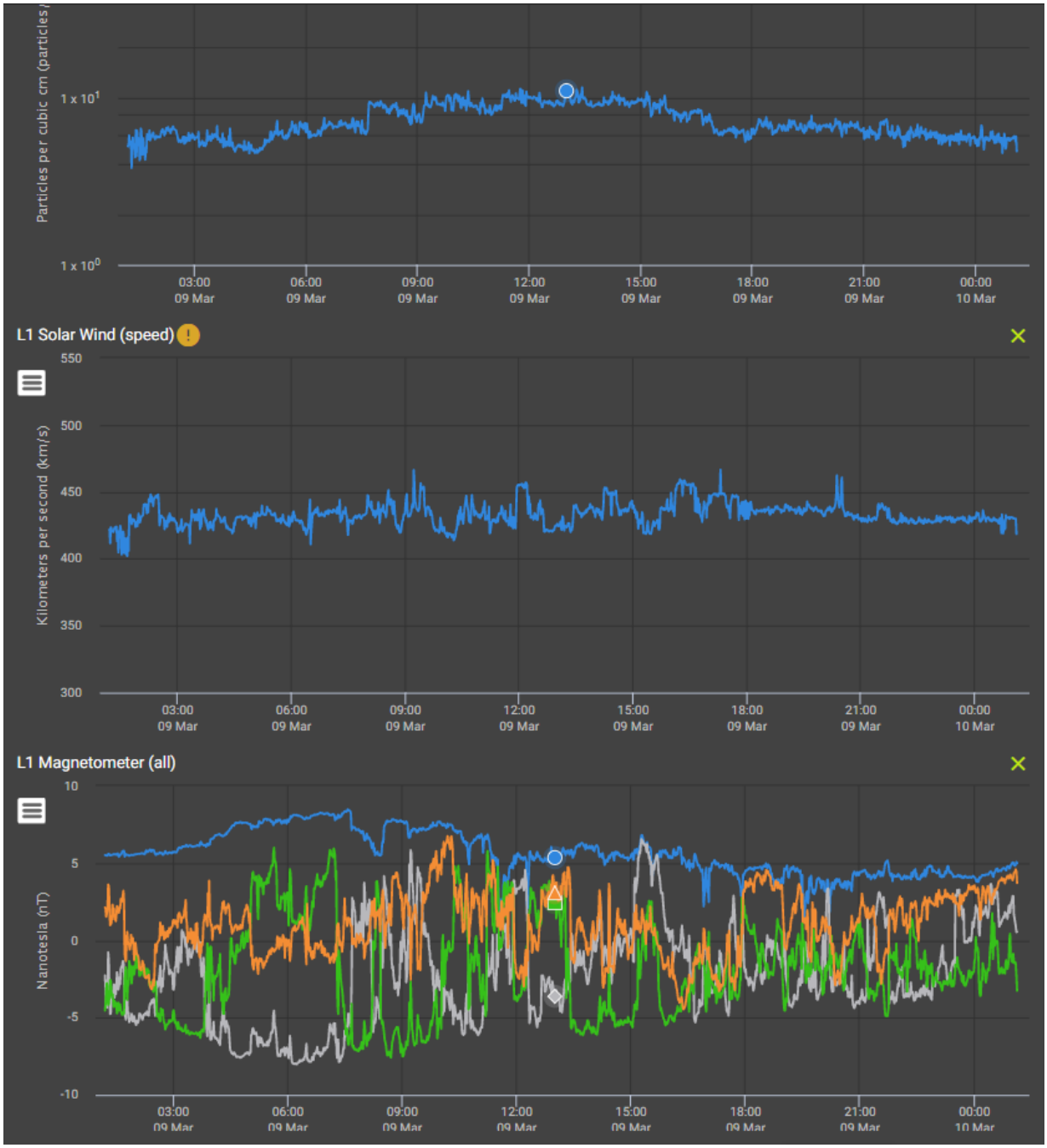
Figure 3: 24 hour solar wind data, with the slight elevation in parameters due to the CME passage clearly visible.



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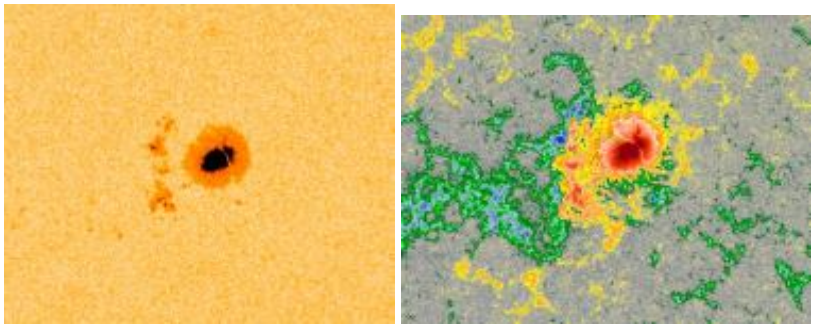
Radio Blackouts - X-Ray Flares:
Solar activity has been Low through the last 24 hours. The two dominant regions on the disc, AR3242 and AR3245 are both large and relatively inactive. AR3245 also initially contained a delta spot, but the region has now simplified magnetically.

A number of regions are magnetically simple and weak, with small areas. Although none are considered to pose a significant risk of flare activity, they continue to be monitored.

Low to Moderate activity is forecast with a slight chance of High activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 4: AR3245 (Dki/βγ) which has become the largest region on the visible disc, but has also weakened after a delta spot faded.



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Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. AR3242 and AR3245 pose the most elevated proton risk. AR3242 is inside the northwest quadrant, with AR3245 rotating into the western hemisphere. Flare risk have been maintained at a steady level, with both spots expected to continue to be visible through the forecast period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has been oscillating between high and moderate levels through the last 24 hours, as the influence of the long-lived high speed streams from coronal holes 81 and 82 wane. In the absence of further coronal holes and with limited geomagnetic activity, electron flux is expected to follow a declining trend through the period, with peaks starting to reach below the high threshold by the end of the period. The BAS radiation belt model is suggesting that there are high electron populations in lower Earth orbits, but with no significant geomagnetic activity forecast and solar wind speeds approaching background levels there appears to be limited mechanisms for the electrons to reach higher orbits.

Electron fluence is expected to follow a declining trend through the period, with no inputs or enhancements into the belts forecast from high speed streams or CMEs.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	50	20	20	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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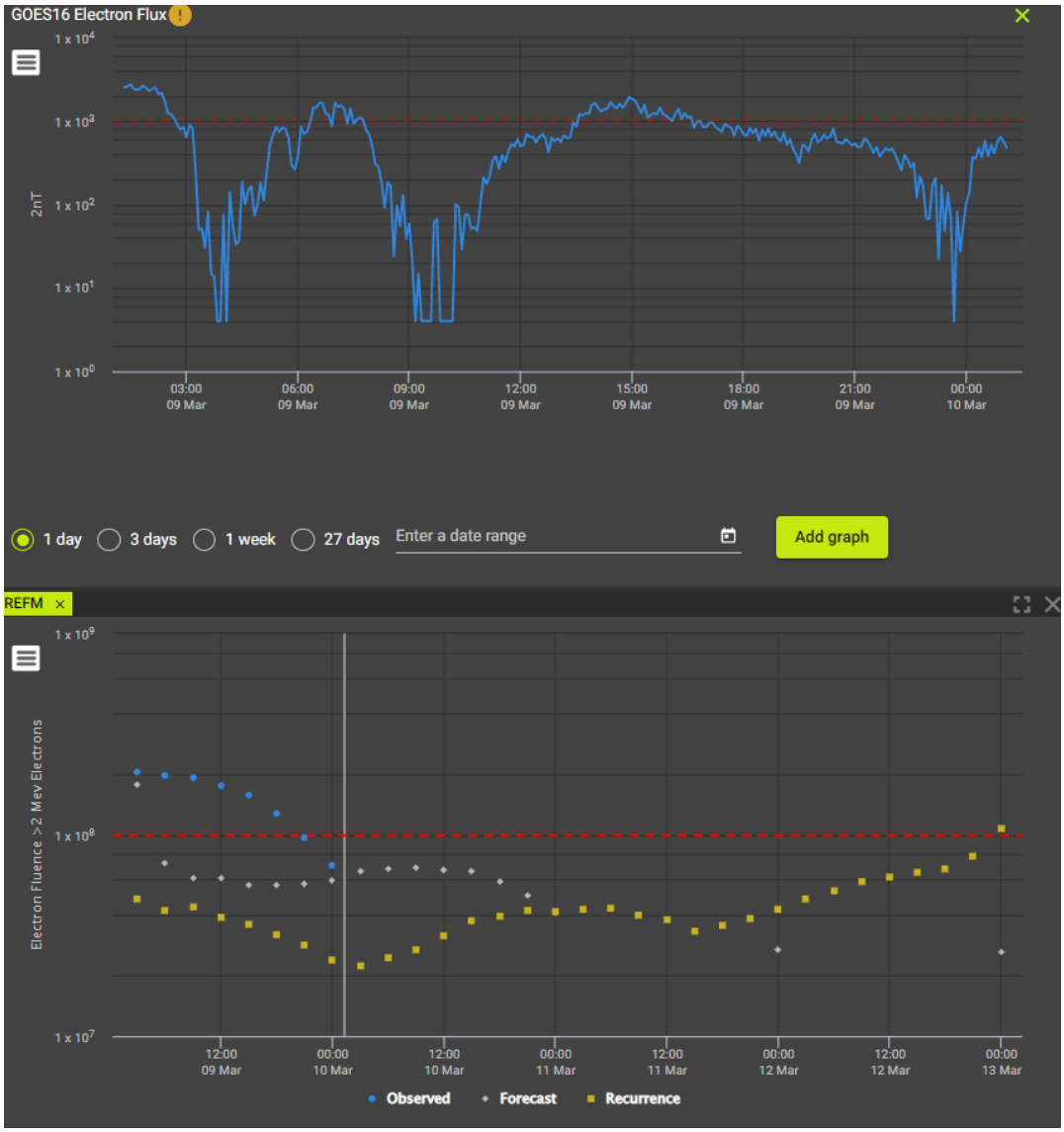
Figure 5: GOES 16 electron flux and MOSWOC REFM model



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